

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent is:

1. A method for providing a requested computing resource service according to terms of a contract, said contract describing conditions of the requested computing resource service, said method comprising:
  - a) providing a first computing resource for fulfilling the resource contract, said first computing resource capable of being controlled by a guarantor of said contract to provide a requested computing service;
  - b) providing a second computing resource capable of providing computing capacity according to a stochastic process, said second computing resource incapable of being controlled by the guarantor; and,
  - c) utilizing the second computing resource for fulfilling the contract and utilizing the first computing resource for guaranteeing the fulfillment of the resource contract if the resource contract is incapable of being fulfilled utilizing only the second computing resource, wherein said contract guarantor accepts the contract with a guarantee to provide the requested computing resource service with the given conditions.
2. The method according to Claim 1, further comprising the step of: offering a contract for providing a computing service, said offered contract capable of being accepted if the contract is fulfilled utilizing the computing capacity of the first computing resource.
3. The method according to Claim 1, whereby the guarantor accepts the contract and guarantees the fulfillment of the contract with a determined possibility, said method further comprising the step of: reserving a respective computing capacity on the first computing resource according to the guaranteed probability for the fulfillment of the contract.
4. The method according to Claim 3, further comprising: calculating the respective computing capacity as a probability distribution of a computing capacity, whereby a

percentile of the probability distribution of the computing capacity of the first computing resource is reserved for guaranteeing the fulfillment of the contract.

5. The method according to claim 1, further comprising the steps of:

monitoring conditions of said second computing resources during fulfilling a contract, and comparing the conditions with the provided computing capacity; and,

detecting a probability of failing contract fulfillment; and,

transferring a remainder of said contract that is not yet fulfilled to the first computing resource if the probability of failing exceeds a given level.

6. The method according to claim 5, further comprising the step of: determining a time tolerance that defines a time before a time limit for fulfilling the contract, said step of monitoring conditions including monitoring the fulfilling of the contract before the time tolerance, and if the contract is not fulfilled before the time tolerance then utilizing the first computing resource for fulfilling the contract.
7. The method according to claim 3, whereby the reserved computing capacity of the first computing resource is used jointly for several accepted contracts, whereby the total quantity of the reserved computing capacity is sufficient for the accepted contracts with a given probability.
8. The method according to claim 1, wherein the second computing resource provides computing capacity for the guarantor during idle states of its own native tasks.
9. The method according to claim 1, further comprising the step of: determining a computing capacity of the second computing resource that the second computing resource could provide on average, and considering as available computing capacity for fulfilling the contract said average second computing resource computing capacity in combination with the computing capacity of the first computing resource.
10. The method according to claim 1, further comprising the step of: calculating the required quantity of the capacity of the first computing resource for fulfilling the contract by using

quantile data of the available computing capacity of the stochastic resource relative to the requirements of the contract.

11. The method according to claim 10, whereby the required quantity of a capacity (R) of the first computing resource is calculated according to the following equation:

$$R(k_1, \dots, k_q) = \sum_{j=1}^{j=q} \max(n - k_j) l_j ,$$

whereby R (k<sub>1</sub>, ..., k<sub>q</sub>) is the required quantity of the capacity of the first computing resource;

whereby k<sub>i</sub> is the number of slots in the quantile;

whereby n is the number of slots requested by the contract in each quantile;

whereby l<sub>j</sub> is the average length of a slot in the j<sup>th</sup> quantile.

12. The method according to claim 10, whereby the probability (P) of needing more than a predetermined quantity (X) of a computing resource is calculated according to the following equation:

$$P\{R > X\} = \sum_{(k_1, \dots, k_q) s.t. \sum k_i = s} P(k_1, \dots, k_q) I(R(k_1, \dots, k_q) > X)$$

whereby P{R>X} is the possibility of needing more than the quantity (X);

whereby P(k<sub>1</sub>, ..., k<sub>q</sub>) is the probability of observing in a random set of s = n·q slots (k<sub>1</sub>, ..., k<sub>q</sub>) in the q quantiles, whereby R(k<sub>1</sub>, ..., k<sub>q</sub>) is the required quantity of the capacity of the first computing resource,

whereby I is an indicator function and X is the predetermined quantity of the first computing resource that is needed for finishing the contract.

13. A system for providing a requested computing resource service according to terms of a contract, said contract describing conditions of the requested computing resource service, said system comprising:

a first computing resource for fulfilling the resource contract, said first computing resource capable of being controlled by a guarantor of said contract to provide a requested computing service; and,

a second computing resource capable of providing computing capacity according to a stochastic process, said second computing resource incapable of being controlled by the by the guarantor; and,

a control means connected to said first and second computing resources for providing a requested computing resource service according to terms of a contract, said controller means utilizing the second computing resource for fulfilling the contract and utilizing the first computing resource for guaranteeing the fulfillment of the resource contract if the resource contract is incapable of being fulfilled utilizing only the second computing resource.

14. The system for providing a requested computing resource according to Claim 13, further comprising an interface device connected to said control means for receiving a contract and enabling a contract guarantor to accept a contract with a guarantee to provide the requested computing resource service according to given conditions.
15. The system for providing a requested computing resource according to Claim 13, wherein said control means comprises:
  - means for determining a computing capacity that may be guaranteed by said first deterministic computing resource; and,
  - means for calculating statistical probabilities for providing computing capacity by the second stochastic computing resources.
16. The system for providing a requested computing resource according to Claim 15, further comprising: means for monitoring conditions of said first and second computing resources during fulfilling a contract, and comparing the conditions with the provided computing capacity;
  - means for detecting a probability of failing contract fulfillment; and,

means for transferring a remainder of said contract that is not yet fulfilled to the first computing resource if the probability of failing exceeds a given level.

17. The system for providing a requested computing resource according to Claim 13, further comprising: a handling means connecting the control means with the second computing resource, said handling means having the ability to stop work it has started on the stochastic resource.
18. The system for providing a requested computing resource according to Claim 14, wherein said second computing resource comprises a computer capacity harvesting system within a grid of computers that harvest free computing capacities of the computers and provide the diverted computing capacity to the control means.
19. A program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform method steps for providing a requested computing resource service according to terms of a contract, said contract describing conditions of the requested computing resource service, said method steps including the steps of:
  - a) providing a first computing resource for fulfilling the resource contract, said first computing resource capable of being controlled by a guarantor of said contract to provide a requested computing service;
  - b) providing a second computing resource capable of providing computing capacity according to a stochastic process, said second computing resource incapable of being controlled by the guarantor; and,
  - c) utilizing the second computing resource for fulfilling the contract and utilizing the first computing resource for guaranteeing the fulfillment of the resource contract if the resource contract is incapable of being fulfilled utilizing only the second computing resource, wherein said contract guarantor accepts the contract with a guarantee to provide the requested computing resource service with the given conditions.
20. The program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine according to Claim 19, wherein the method steps

further comprise the step of: offering a contract for providing a computing service, said offered contract capable of being accepted if the contract is fulfilled utilizing the computing capacity of the first computing resource.

21. The program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine according to Claim 19, whereby the guarantor accepts the contract and guarantees the fulfillment of the contract with a determined possibility, said method steps further comprising the step of: reserving a respective computing capacity on the first computing resource according to the guaranteed probability for the fulfillment of the contract.
22. The program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine according to Claim 21, wherein the method steps further comprise the step of: calculating the respective computing capacity as a probability distribution of a computing capacity, whereby a percentile of the probability distribution of the computing capacity of the first computing resource is reserved for guaranteeing the fulfillment of the contract.
23. The program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine according to Claim 19, wherein the method steps further comprise the steps of:

monitoring conditions of said second computing resources during fulfilling a contract, and comparing the conditions with the provided computing capacity; and,

detecting a probability of failing contract fulfillment; and,

transferring a remainder of said contract that is not yet fulfilled to the first computing resource if the probability of failing exceeds a given level.
24. The program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine according to Claim 23, wherein the method steps further comprise the steps of: determining a time tolerance that defines a time before a time limit for fulfilling the contract, said step of monitoring conditions including monitoring the fulfilling of the contract before the time tolerance, and if the contract is not

fulfilled before the time tolerance then utilizing the first computing resource for fulfilling the contract.

25. The program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine according to Claim 21, wherein the reserved computing capacity of the first computing resource is used jointly for several accepted contracts, whereby the total quantity of the reserved computing capacity is sufficient for the accepted contracts with a given probability.
26. The program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine according to Claim 19, wherein the method steps further comprise the step of: determining a computing capacity of the second computing resource that the second computing resource could provide on average, and considering as available computing capacity for fulfilling the contract said average second computing resource computing capacity in combination with the computing capacity of the first computing resource.
27. The program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine according to Claim 19, wherein the method steps further comprise the step of: calculating the required quantity of the capacity of the first computing resource for fulfilling the contract by using quantile data of the available computing capacity of the stochastic resource relative to the requirements of the contract.
28. The program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine according to Claim 27, whereby the required quantity of a capacity (R) of the first computing resource is calculated according to the following equation:

$$R(k_1, \dots, k_q) = \sum_{j=1}^{j=q} \max(n - k_j) l_j ,$$

whereby R (k<sub>1</sub>, ..., k<sub>q</sub>) is the required quantity of the capacity of the first computing resource;

whereby k<sub>i</sub> is the number of slots in the quantile;

whereby n is the number of slots requested by the contract in each quantile;

whereby  $l_j$  is the average length of a slot in the  $j^{\text{th}}$  quantile.

29. The program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine according to Claim 28, whereby the probability (P) of needing more than a predetermined quantity (X) of a computing resource is calculated according to the following equation:

$$P\{R > X\} = \sum_{(k_1, \dots, k_q) \text{ s.t. } \sum k_i = s} P(k_1, \dots, k_q) I(R(k_1, \dots, k_q) > X)$$

whereby  $P\{R > X\}$  is the possibility of needing more than the quantity (X);

whereby  $P(k_1, \dots, k_q)$  is the probability of observing in a random set of  $s = n \cdot q$  slots  $(k_1, \dots, k_q)$  in the  $q$  quantiles, whereby  $R(k_1, \dots, k_q)$  is the required quantity of the capacity of the first computing resource,

whereby  $I$  is an indicator function and  $X$  is the predetermined quantity of the first computing resource that is needed for finishing the contract.